NISTTech

Apparatus & Method for Diffraction Measurement using a Scanning X-Ray Source

Description

A method for gathering x-ray diffraction (XRD) measurements uses a scanning x-ray source, a specimen, a collimator (narrows a beam of waves), and a point detector. A neutron or gamma ray source could be used in addition to an x-ray source. The x-rays from the scanning radiation source are diffracted by the specimen, and enter the detector via the collimator.

The detector can detect the intensity and/or the wavelength of the diffracted x-ray, and all information needed to solve the Bragg equation. The detection tasks and the angle determination tasks are completely separated and no motion of the detector is needed. The detector may be easily and inexpensively optimized for sensitivity in either intensity, or wavelength determination or both. Moving-source XRD allows good spatial resolution in two or more dimensions, high sensitivity, good wavelength resolution and rapid data acquisition.

The method uses a technique to produce Laue patterns that include high-resolution wavelength information. The full, three-dimensional, Laue equations may be applied to XRD measurements so each diffracted ray may be independently used to determine the atomic spacing "d". This enhanced Laue method may be effectively applied to not just single crystals, but to a very broad range of specimens.

Applications

- **Manufacturing (Jet turbine blades)**
  Measures crystalline orientation and structure, and optimizes processes to consistently and quickly grow single-crystal blades
- **Chemical analysis**
  Measures chemical (phase) and texture (anisotropic crystalline orientation)
- **X-ray optics**
  May be used in conjunction with capillary bundles as well as a simple collimator
- **All x-ray diffraction measurements**
  Broad application in many fields

Advantages

- **Rapid x-ray diffraction (XRD) measurements**
  Greater rate of throughput than systems using mechanical movement

since the electronic movement of the source is much more rapid

- **Reduced time and better images**
  More information is gathered in less time since a large spectrum of diffracted x-rays are gathered simultaneously and with great sensitivity - provides both superior spatial and wavelength resolution over a large range of diffraction angles
- **Comparably cheaper and simpler design**
  Relatively uncomplicated and inexpensive in comparison with other forms of X-ray diffraction equipment
- **Enhanced resolution**
  The scanning x-ray source XRD method also enables magnification of an area of the XRD pattern produced by a specimen without movement of the specimen

Abstract

The present invention relates to x-ray diffraction measurement by using moving x-ray source x-ray diffraction. The invention comprises a raster-scanned x-ray source, a specimen, a collimator, and a detector. The x-ray source is electronically scanned which allows a complete image of the x-ray diffraction characteristics of the specimen to be produced. The specimen is placed remote from the x-ray source and the detector. The collimator is located directly in front of the detector. The x-rays are diffracted by the specimen at certain angles, which cause them to travel through the collimator and to the detector. The detector may be placed in any radial location relative to the specimen in order to take the necessary measurements. The detector can detect the intensity and/or the wavelength of the diffracted x-rays. All information needed to solve the Bragg equation as well as the Laue equations is available. The x-ray source may be scanned electronically or mechanically. The present invention is used to perform texture analysis and phase identification.

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Related Items

- Article: X-Ray Sensor Casts Better Blades

References

- Expired U.S. Patent # 6,269,144
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Status of Availability

This technology is available in the public domain.

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